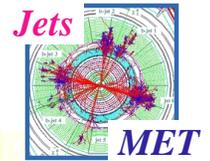




# UPDATE ON L2 SUSY TRIGGER OPTIMIZATION



S.Abdullin, UMD



- Talk at CMS week :

[http://cmsdoc.cern.ch/~abdullin/jetmet/meetings/cmsweek\\_dec01/SUSY\\_HLT.pdf](http://cmsdoc.cern.ch/~abdullin/jetmet/meetings/cmsweek_dec01/SUSY_HLT.pdf)

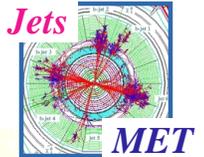
- Talk at Jets/MET meeting (20 Dec 2002) :

<http://cmsdoc.cern.ch/~abdullin/jetmet/meetings/20dec01/talk.pdf>

- Various mSUGRA points analysed, though some aspects only ...
- Optimization algorithm written and tested
- Now concentrate on Tevatron reach in mSUGRA model
- "Global optimization" is possible ?

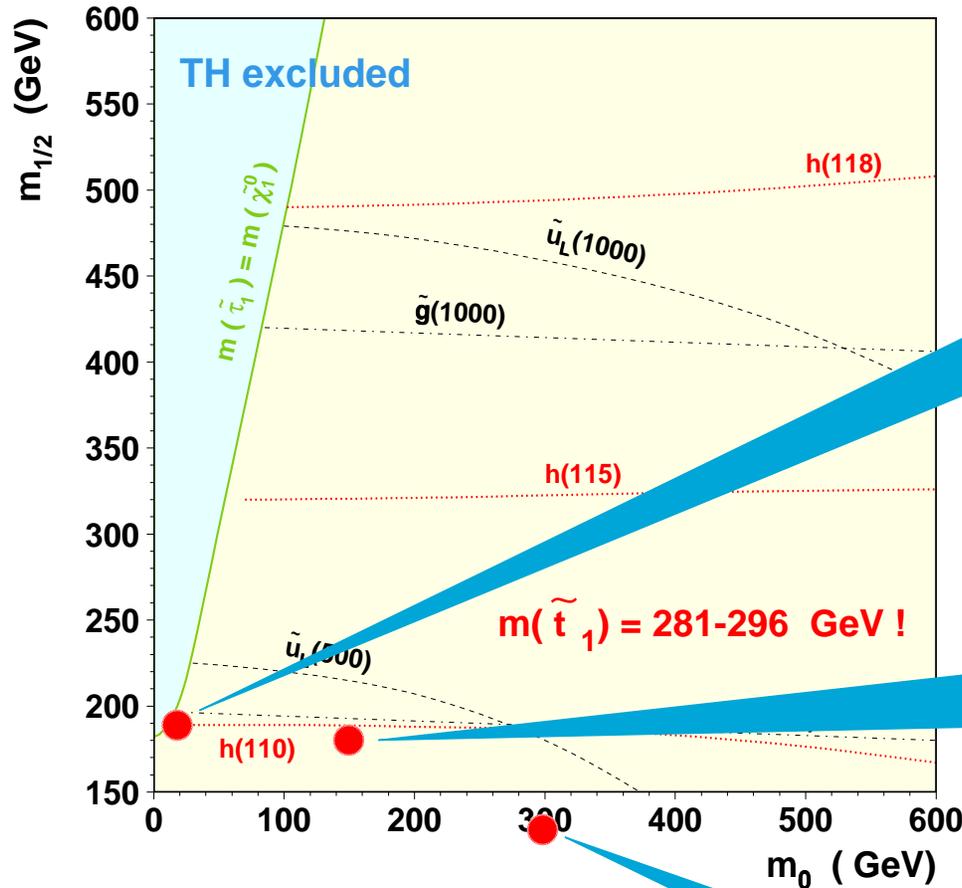


# WHERE THE TEVATRON REACH ENDS ...



H.Baer et al., hep-ph/9802441; Phys.Rev.D58:075008, 1998

$A_0 = 0, \tan\beta = 10, \mu > 0$



Require  $\int Ldt < 10 \text{ pb}^{-1}$

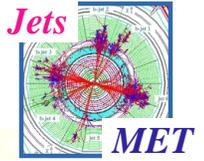
$m(\tilde{\chi}_1^0) = 70 \text{ GeV}$      $m(h) = 110 \text{ GeV}$   
 $m(\tilde{g}) = 466 \text{ GeV}$      $m(\tilde{u}_L) = 410 \text{ GeV}$   
 $\sigma \sim 181 \text{ pb}$     tau-enriched,  
**4**    **20,190**    quite enough sleptons

$m(\tilde{\chi}_1^0) = 66 \text{ GeV}$      $m(h) = 110 \text{ GeV}$   
 $m(\tilde{g}) = 447 \text{ GeV}$      $m(\tilde{u}_L) = 415 \text{ GeV}$   
 $\sigma \sim 213 \text{ pb}$     nothing special  
**5**    **150,180**

$m(\tilde{\chi}_1^0) = 45 \text{ GeV}$      $m(h) = 106 \text{ GeV}$   
 $m(\tilde{g}) = 349 \text{ GeV}$      $m(\tilde{u}_L) = 406 \text{ GeV}$   
 $\sigma \sim 500 \text{ pb}$      $\tilde{q} \rightarrow \tilde{g} + X, \tilde{g} \rightarrow 3 \text{ body},$   
**6**    **300,130**    more jets, less MET



# R-PARITY VIOLATION SCENARIO ...



- ☞ To avoid coupling of fermions to sfermions and fermions simultaneously (lepton and/or baryon number non-conservation)

$$R = (-1)^{3(B-L) + 2S}$$

- ☞ Consequences :

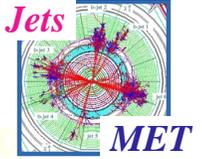
- sparticles produced in pairs
- lightest sparticle (LSP) is stable
- interactions of particles and sparticles can differ

- ☞ Here the simplest (and most challenging) case of R-parity violation is considered :

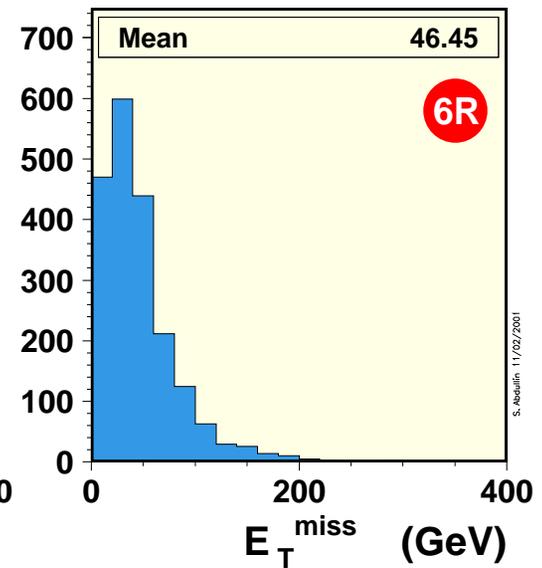
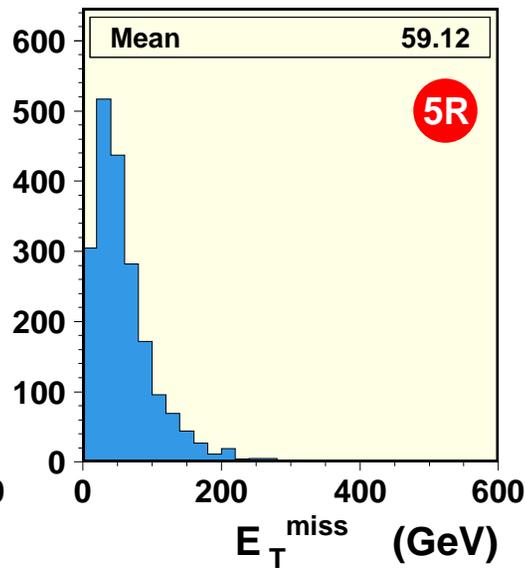
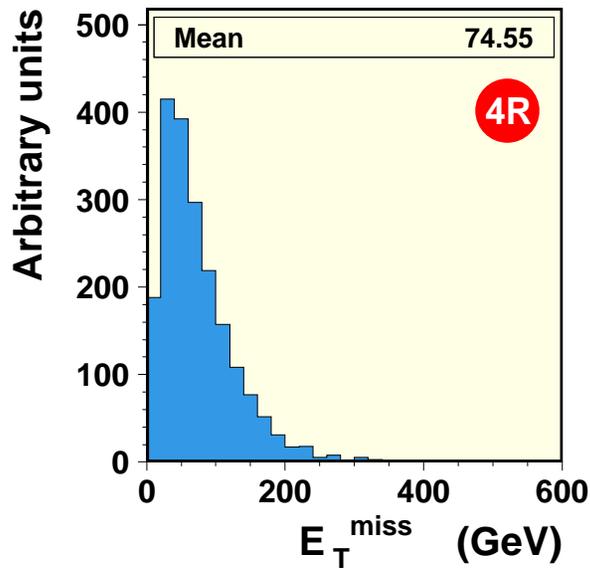
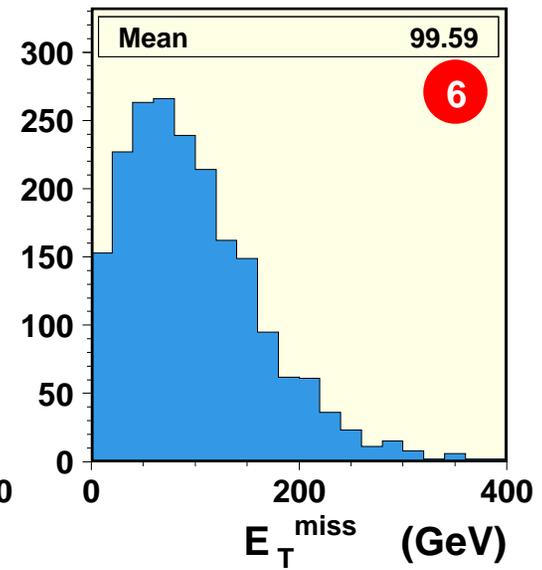
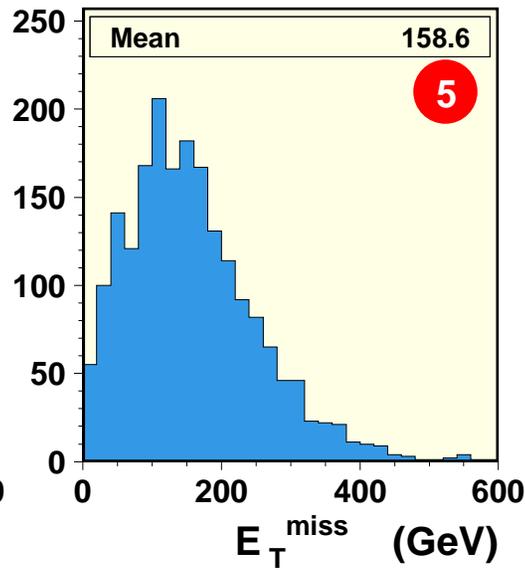
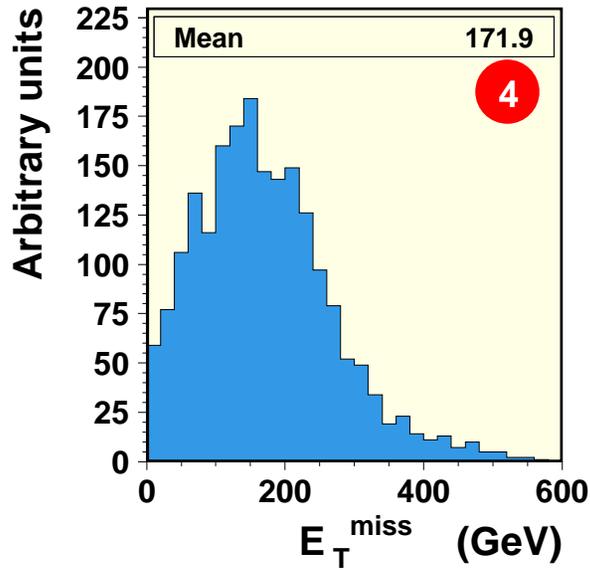
- $\tilde{\chi}_1^0 \rightarrow 3$  quarks
- one might expect 6 additional jets ?



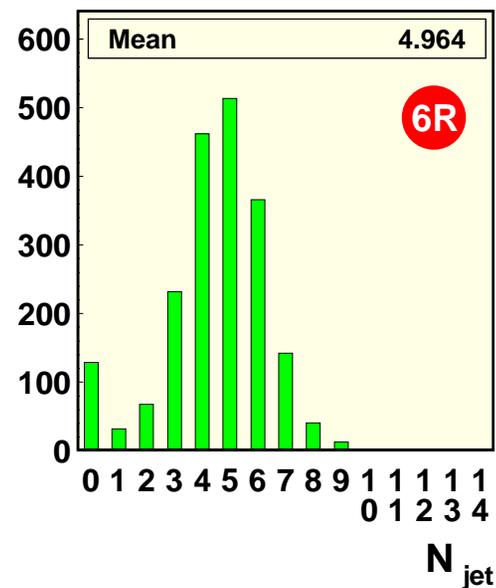
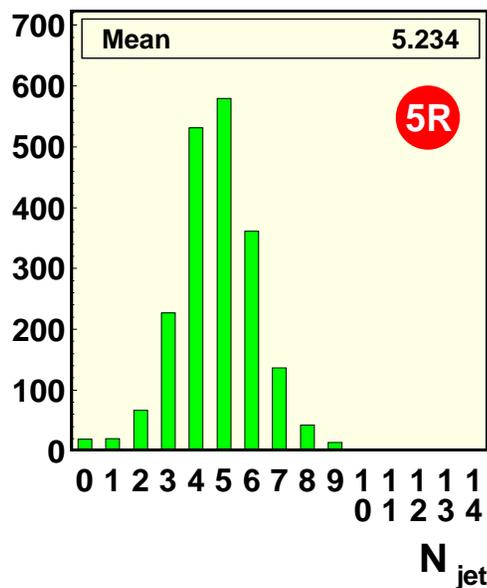
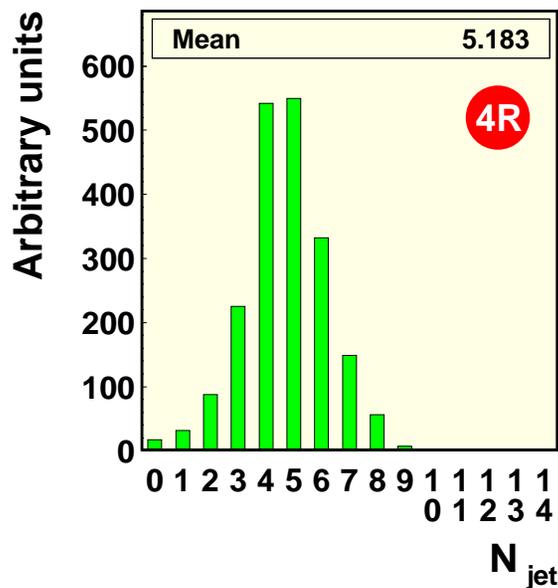
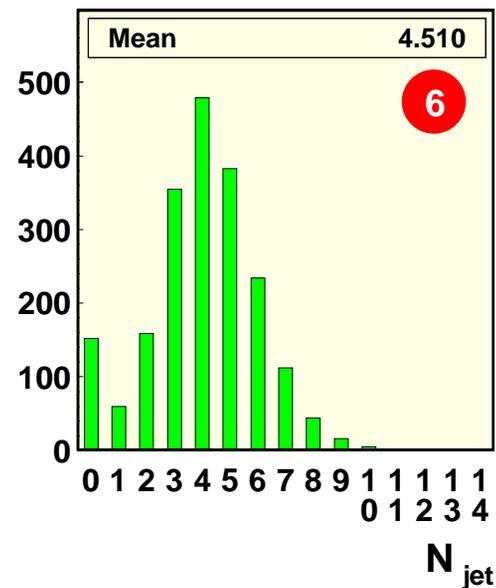
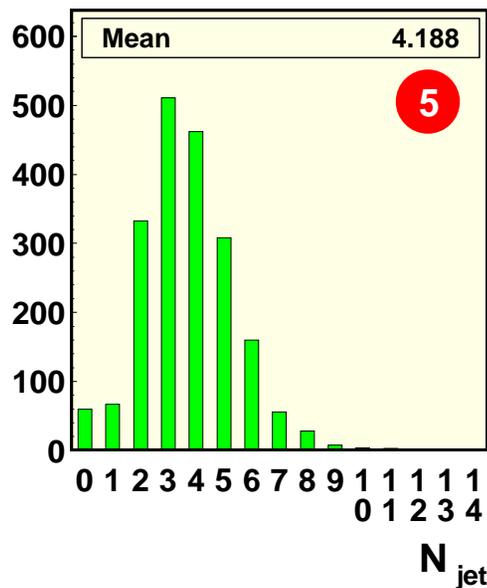
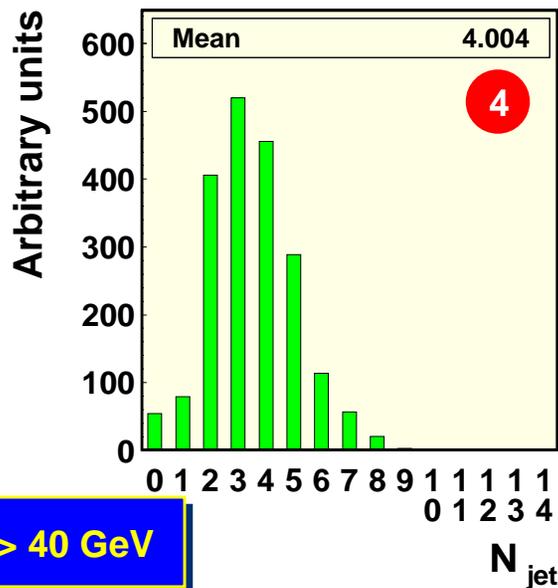
# THE SAME 3 PROBING POINTS, BUT WITH $R$ -PARITY



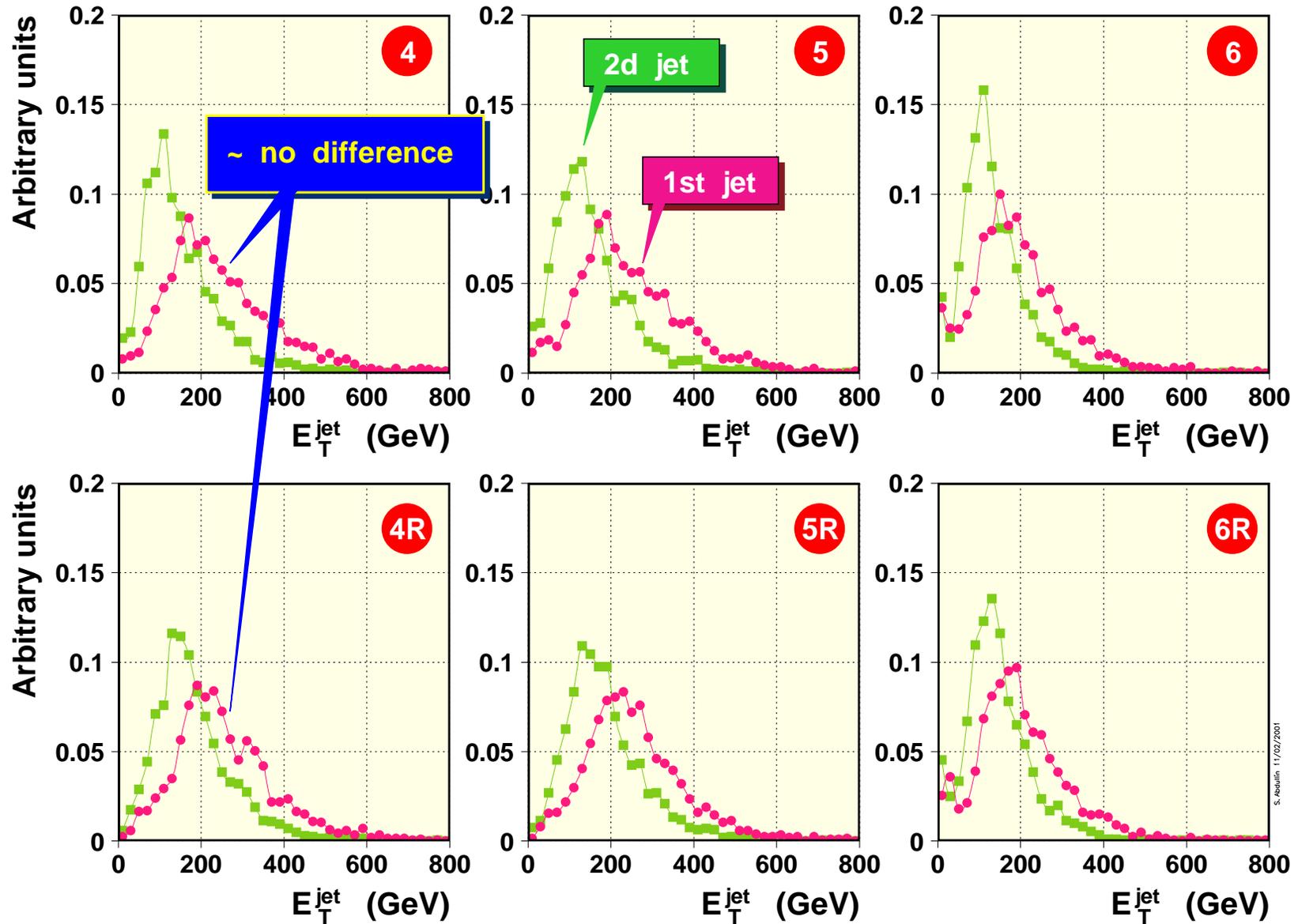
- The same 3 "Tevatron reach" points are taken and undergo "surgery" with the help of
  - ☞ ISAJET 7.51
  - ☞ ISAWIG 1.104
  - ☞ HERWIG 6.301to eventually acquire R-parity broken : **Points** **4R** **5R** **6R**
  
- MET shrinks (no  $\tilde{\chi}_1^0$ ) but not completely
  - copious b-jet production (lightest stop and sbottom)
  - for  $\tan\beta > 5$  increasing  $\tau$  couplings :  $\tilde{\chi}_1^+ \tilde{\chi}_2^0 \rightarrow \tau (\tau) + X$
  - W's from both top and sparticle decays
  
- Additional jets are expected to be rather soft ...
  - $m(\tilde{\chi}_1^0) = 45-70$  GeV



S. Abdullin, 11/02/2001

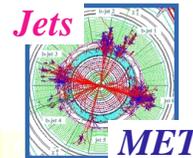


S. Abdullin 11/02/2002





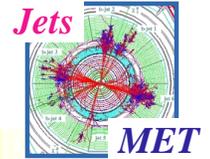
# HOW HIGH RATE COULD WE AFFORD @ L2



- Something like ~ 4 kHz for Jets/MET @ L1 (?)
  - 2 + 2 for tau physics and other jets/MET channels
- Something like ~ 6 Hz for Jets/MET @ L2 (?)
  - 3 + 3 for tau physics and other jets/MET channels
- Assuming 3 Hz at our disposal :
  - MET + 1-2 jets      $m(\text{gluino}) \gg m(\text{squark})$
  - MET + 3-4 jets      $m(\text{gluino}) \sim m(\text{squark})$
  - 4 or more jets      $m(\text{gluino}) < m(\text{squark})$  or ~~R~~-parity  
and small MET
- As we don't know what the SUSY might look like,  
probably we should try to cope with "everything" ...



# A SIMPLE GENETIC ALGORITHM



- "Society of individuals" (fixed-size population ~ 100) with some established hierarchy, e.g. descending ordering of certain function of parameters ("genes") with a few "behaviour" functions defined

- breeding
- mutation
- "death / birth"
- selection

*might be a variety of definitions*

- A generation-by-generation process ...

- more details in

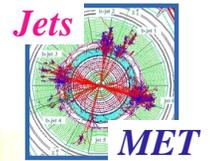
<http://cmsdoc.cern.ch/~abdullin/jetmet/meetings/20dec01/talk.pdf>

## Jets and MET $E_T$ cuts (GeV) for optimal signal efficiency @ L2

		J2 + MET		J3 + MET		MET	J4 + MET		J1 + MET	
		60	120	40	100	150	70	90	80	230
Signal efficiency (%)	Point <b>4</b>	62.4(62.4)	69.8(58.2)	72.6(54.5)	73.5(16.8)	73.5(24.1)				
	Point <b>5</b>	56.5(56.5)	66.6(57.5)	68.8(47.4)	70.2(19.5)	70.2(20.0)				
	Point <b>6</b>	30.6(30.6)	40.7(38.2)	41.5(20.0)	43.6(16.0)	43.6(4.3)				
QCD + $t\bar{t}$	rate (Hz)	1.89(1.89)	2.96(2.12)	2.96(0.94)	3.08(0.38)	3.08(0.29)				
		J4 + MET		J3 + MET		J2 + MET	J1 + MET		MET	
		70	60	60	100	200 190	230	230	220	
Signal efficiency (%)	Point <b>4R</b>	24.1(24.1)	34.3(22.2)	34.3(2.2)	34.4(2.0)	34.5(2.4)				
	Point <b>5R</b>	19.2(19.2)	24.7(13.3)	24.8(1.4)	24.8(1.4)	24.9(1.1)				
	Point <b>6R</b>	11.6(11.6)	14.5(6.7)	14.6(0.6)	14.6(0.4)	14.7(0.4)				
QCD + $t\bar{t}$	rate (Hz)	1.90(1.90)	2.93(1.29)	2.96(0.07)	3.10(0.29)	3.11(0.30)				



# RESULTS (II)



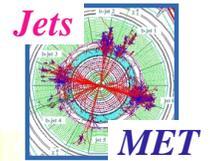
## Jets and MET $E_T$ cuts (GeV) for optimal signal efficiency @ L2

		J3 + MET		J4 + MET		MET	J2 + MET		J1 + MET	
		50	100	70	70	150	40	140	40	150
Signal efficiency (%)	Point 4	51.7(51.7)		54.0(18.2)		70.8(54.5)	72.2(57.7)		72.2(54.5)	
	Point 5	51.0(51.0)		54.3(21.4)		68.0(47.4)	69.1(51.3)		69.1(47.4)	
	Point 6	35.2(35.2)		41.3(19.9)		44.7(20.0)	45.2(23.6)		45.2(20.0)	
	Point 4R	22.8(22.8)		31.2(20.4)		31.6(9.1)	31.8(11.2)		31.8(9.1)	
	Point 5R	13.7(13.7)		20.9(15.0)		21.2(4.7)	21.3(6.1)		21.3(4.7)	
	Point 6R	7.2(7.2)		12.4(9.0)		12.6(2.5)	12.6(3.2)		12.6(2.5)	**
QCD + $t\bar{t}$	rate (Hz)	1.67(1.67)		2.45(1.04)		2.97(0.94)	3.08(1.12)		3.08(0.94)	

\*\* 15.2 % max (if alone) @ 3 Hz



# DISCUSSION



## ■ To add :

- W + jet sample is available (lepton + neutrino forced)
- topological and global variables (3-4 jet + MET though ...)
- MET refinement ?

Despite a few clearly bad events were thrown away,  
1 Hz rate at L2 with MET ~ 150 GeV  
(average Branson weights, **entire** HLT sample)

## ■ L1 cuts to be looked at ...

## ■ "Common place" - multijet rates aren't well known (to put it mildly)